Ikuko SHIHIRA*: **The characteristics of the thallus of *Monostroma***

志平依久子*: ヒトエグサの藻体の特異性

with 1 plate

Introduction

Monostroma nitidium grows luxuriantly on the rocky shore in the vicinity of the Misaki Marine Biological Station in winter and spring. The fronds produce gametes from January until they disappear in the end of May. These gametes conjugate and form a zygote which survives the summer season as a unicellular zygote. In autumn, this zygocyst produces many zoospores which swim out and develop into the *Monostroma*-frond of the gametophyte. Therefore, in this report, 'maturation' means the process by which vegetative cells change to reproductive cells, or gametangia.

Many full mature fronds of *Monostroma* can be found at intervals of about fifteen days. Such a periodicity of maturation has been investigated from the following viewpoint: i. e., understanding the characteristics of the cells in the thallus, and discovering how the cell reacts to the enviromental factors. Among these problems, only the morphological aspects are reported in the present paper. It is found that each cell of *Monostroma* has the ability to live independently when discharged from the frond as a unicellular alga. The phylogenetic position of *Monostroma* is discussed.

Observations and Results

The thallus of *Monostroma* consists of one cell layer. The maximum length of the thallus in the vicinity of Misaki is about 6 cm from the base to the margin. When it becomes mature, a certain area of the marginal part changes to yellow, where the cells include many gametes.

In *Enteromorpha* or *Ulva*, the maturing and vegetative parts are demarcated by a straight line, while the border between them is irregular in *Monostroma*. Fertile cells become round and larger in surface view. The intercellular matrix becomes softer as the maturation proceeds; as seen in cross-section, mature cells or gametangia move above and below making a zig-zag layer (Pl. I-2).

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Careful microscopic examination brings to light a gradual transition of cell-shape from the margin to the base even of the thallus. The cells in the marginal part are comparatively round (Pl. I-3); as they approach the base they look rather square; while the cells near the base project colorless strands to the base, becoming 'rhizoidal cells' (Pl. I-4). Such transition of cell-shape suggests that individual cells have different potencies for maturation, proceeding inward from the margin, and gradient of potencies in a single frond is suggested.

The following experiments were made for understanding the potency of various parts of a frond:

1) When the basal part was cut off, and the rest of the frond was kept in sea-water, the maturation of the frond lacking a basal part was neither accelerated nor delayed.

2) In the unripe part, the distance from the base was artificially increased by

Tab. 1. Gradient of maturing capacity of different part of a frond

Part number / Grade	I	II	III	IV	V
0 (%)				1	5
10				2	6
20				1	
30				1	3
40					1
50				1	1
60			2	3	
70			2	1	
80		1	5	2	1
90		1	2	5	1
100	20	18	9	2	2

Remarks:
Part number: Strips cut parallel to edge of frond. (edge part I- basal part V)
Grade: % of maturing area of fragments.

cutting the frond or making a hole in it. But such portions did not mature earier or later than the untreated part, or whole frond.

3) A frond consisting of vegetative cells was divided into five concentric strips parallel to the edge of the frond, and each strip was cultured separately. It was observed that 100 per cent of the fragments matured in the pieces from the outer strip, and nearer the strip was to the base the less maturation it showed.

4) Thalli having no reproductive cells themselves were separated into fan-shaped pieces by cuts through the base; when each piece matured, its maturation pattern fitted perfectly with that of the neiboring pieces.

5) The cells near the base had the ability to form rhizoids at the edge of the pieces (Pl. I-5). Such phenomenon never occurred in the outer cells from the center of a frond.

6) By keeping the frond in darkness for several days, vegetative cells especially those in the marginal part, were isolated freely after the decay of the intercellular matrix. These isolated cells became round, stayed alive and finally produced gametes inside themselves if the environmental conditions were favorable. A similar phenomenon was observed also on the free cells isolated with the Potter Elvehjem glass homogenizer (Pl. I-6).

7) Many small pieces of 2 mm^2 which were made by cutting vegetative thallus produced gametes after a week. Smaller pieces which were cut by a syringe needle also matured after being cultured for several days.

8) The marginal cells of small pieces made by cutting became free in the surrounding sea-water even in the case of pieces from the basal region.

The observations above show that the individual cells of *Monostroma* have a capacity for independence and according to their arrangement in a frond they have various characteristics.

This fact led to the supposition that the individual cell resembles a unicellular alga and the structure of the *Monostroma*-frond is similar to some modification of a colony form.

Discussion

The Ulotricales including *Monostroma*, and the Chlorococcales including the Chlorellaceae have been placed side by side in the classification. In most cases, *Monostroma* has been included in the Ulvaceae but Kunieda (1936) proposed a separate family, consisting of only the single genus, '*Monostrama*.' From the biochemical viewpoint, it was found by Miwa that intercellular substance in *Monostroma* is more plentiful than it in the other species of Ulvaceae. The present observation indicates that each cell of *Monostroma* has a high degree of independence, like a unicellular alga and the frond, as a whole, closely resembles the colonial form found in the Chlorococcales or Volvocales. According to this viewpoint, *Monostroma* is supposed to be most primitive among the multicellular algae, and should be assigned the lowest status among them.

Summary

The morphological characters of the thallus and cellus of *Monostroma* were investigated. Various parts of a frond were cut out, and their characteristics were observed. The capacity for maturation is greater in the marginal part of the frond, and the capacity for rhizoid formation high in the bgsal part. Individual cells have capacity for independence as if they were unicellular algae. As a whole, it was observed that the cells having different capacities in the different parts of the frond are arranged as if the frond were a colonial form.

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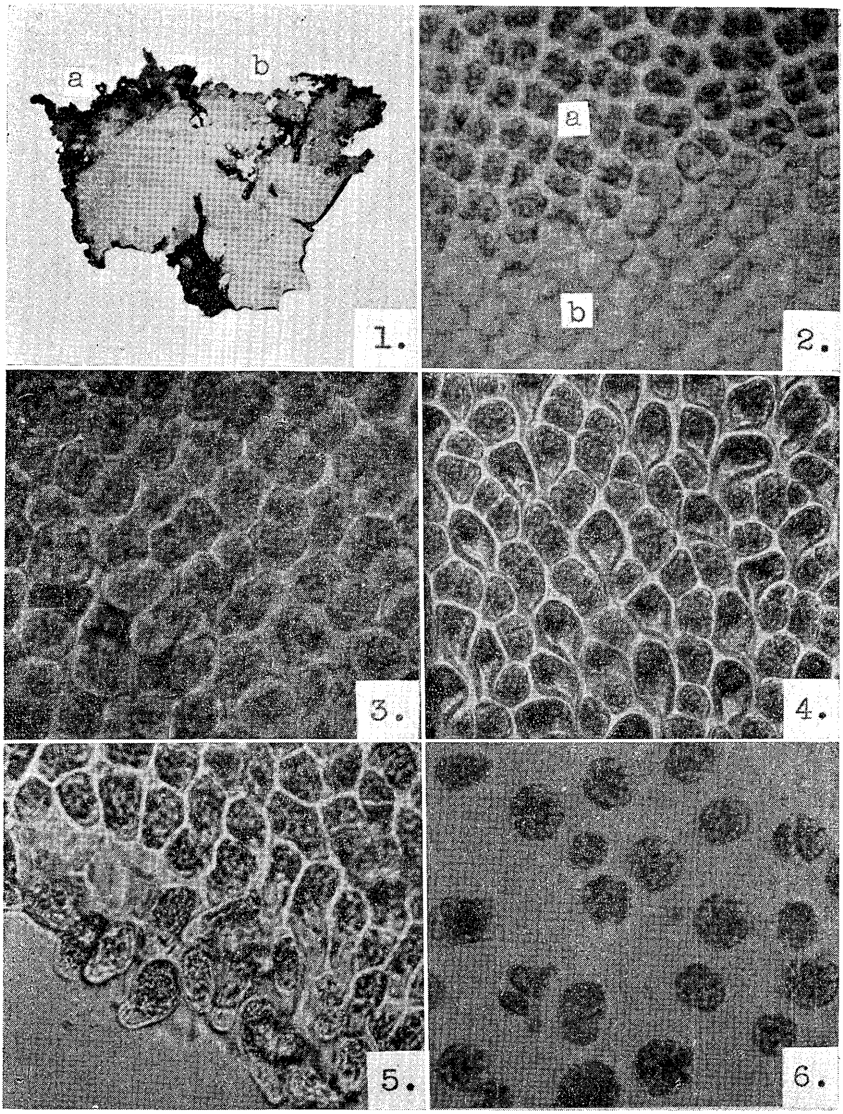

1. Whole frond. a. mature portion of frond, b. portion of frond that has already released its gametes. 2. The border between maturing part and vegetative part. a. maturing part, b. vegetative part. 3. Round-shaped cells at marginal part of frond 4. Rhizoidal cells near base of frond in natural condition. 5. Terminal cells which formed rhizoid in cultivated pieces. 6. Gamete-forming cells isolated from frond.

I. SHIHIRA: Thallus of *Monostroma*